32. Improving the quality of the nation's water is just one of many things we all have to pay for as taxpayers and as consumers. That is, the costs of things like improving water quality are paid partly by government out of what we pay in taxes and partly by companies out of what we pay for the things they sell us.

This scale card shows about how much people in your general income category paid in 1979 in taxes and higher prices for things like national defense, roads and highways, public schools and the space program. (HAND RESPONDENT APPROPRIATE SCALE CARD D-I, D-II, D-III OR D-IV; LET RESPONDENT KEEP WATER QUALITY LADDER CARD)

You will see different amounts of money listed with words like "highways" and "public education" appearing by the amount of money average size households paid for each one last year. "Highways" here refers to the construction and maintenance of all the nation's highways and roads. "Public education" refers to all public elementary and secondary schools but does not include the costs of public universities.

I want to ask you some questions about what amounts of money, if any, you would be willing to pay for varying levels of overall water quality in the nation's lakes, rivers and streams. Please keep in mind that the money would go for sewage treatment plants in communities through various kinds of taxes (such as withholding taxes, sales taxes and sewage fees) and for pollution control equipment the government would require industries to install, thus raising the prices of what they make.

You will also see on the scale card the amount of money the average household in your general income category paid last year in taxes and higher prices to improve the water quality of the nation's lakes and rivers. This share of the nation's expenditures to fight water pollution has meant that so far the average quality of these bodies of water has been raised from level E to level D on the ladder. (POINT TO LEVELS E AND D ON WATER QUALITY LADDER CARD) If this amount of money continues to be spent each year, the quality of the water will be raised up to level C (POINT TO LEVEL C) in the next few years—that is, where virtually all of it would be at least clean enough for fishing.

First, as far as you are concerned, are you willing to pay this amount each year to raise water quality to level C or not?

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No, not willing	
Not sure	(SKIP TO 84)

83.	What about getting the nation's lakes and
	rivers up to level B on the ladder? Including
	the amount of money indicated on the card to
	get water quality up to level C, how much are
	you willing to pay in taxes and higher prices
	each year to raise the water quality to level
	Bthat is where virtually all the nation's
	lakes, rivers and streams are at least clean
	enough to swim in safely?

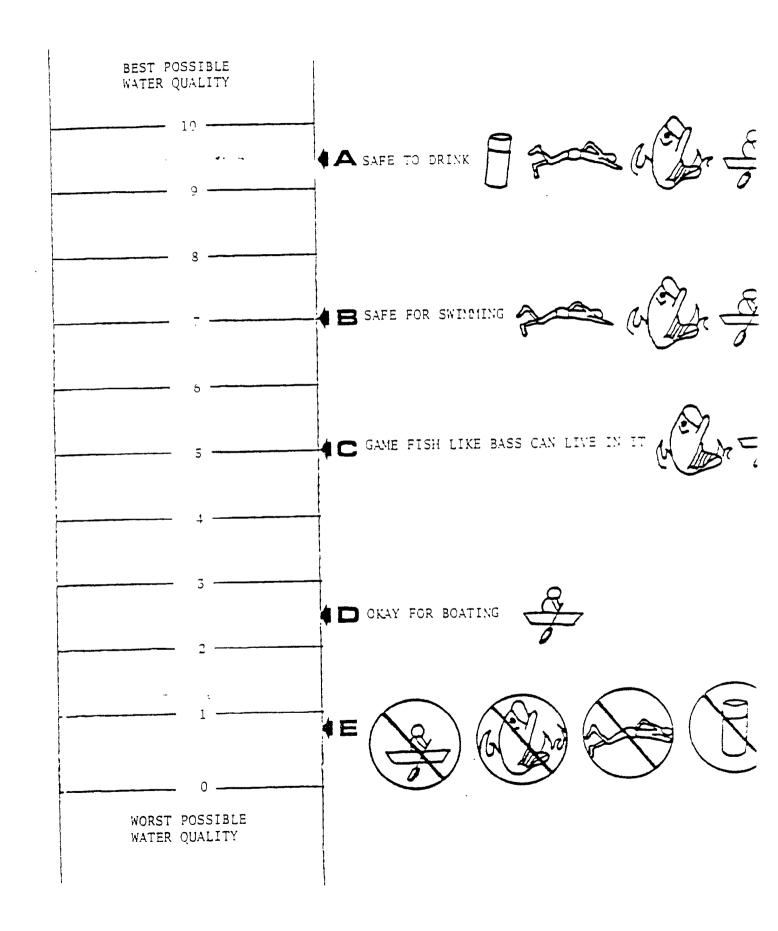
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84. What about the amount of money to keep the quality of water at level D? How much do you think you would be willing to pay each year in taxes and higher prices, if anything, to keep the nation's overall water quality from slipping below level D to level Z where it once was? If it is not worth anything to you, please do not hesitate to say so.

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Appendix II

THE WATER OUALITY LADDER

William J. Vaughan

Water quality can either be described in terms of the uses for which a particular body of water is suitable or in terms of the objective characteristics of the water itself. In turn, objective characteristics traverse a continuum from those that are readily perceptible to those that can only be detected by scientific measurement. In certain dimensions (e.g., visible phenomena such as the extent of algal growth, the clearness of the water, and the existence of suds, foam or debris (David, 1971)) people at large find it easy to preceive changes in water quality. However, some characteristics which delineate water quality levels more finely, such as dissolved oxygen content, escape visual and olfactory perception. Thus it is not surprising that people's ratings of water quality levels are likely to exhibit a less-than-perfect degree of association with any one or a combination of the several scientific measures of quality conditions (Binkley and Hanemann, 1978). This poses a problem for benefit estimation because the existence of a positive willingness to pay for water quality improvement depends upon the ability of people to perceive water quality changes when such changes do, in fact, occur.

This problem has lead previous investigators either to attempt to engineer the fortunate marriage of an objective water quality index (based on some weighted combination of scientific quality parameters) and a subjective index of publicly perceived quality (Bouwes and Schneider, 1979) or to link subjective indices of public perception. and expert perception (Dornbusch, 1975).

We chose to describe water quality primarily in terms of the uses for which water becomes suitable, and secondarily in terms of a few obvious water quality conditions (clearness, odor, debris, etc.). However, we located the numerical position of the five posited water quality levels (Boatable, Fishable-2 levels, Swimmable, Drinkable) by indexing a set of five objective scientific water quality parameters using a variant of the National Sanitation Foundation's Water Quality Index (Booth et al., 1976; McClelland, 1974) along with informed judgment. In so doing we hope to extablish, ex-ante, an admittedly tenuous link between scientifically measured quality characteristics (anchors of the rating scale) and perceived water quality characteristics (the use and readily perceivable objective characteristic descriptors of these anchors).

Specifically, a number of sources were consulted to ascertain the minimally acceptable concentration levels of five measurable quality characteristics associated with five potential uses of natural water courses. These were fecal coliforms (organisms/100 ml), dissolved oxygen (mg/1), maximum BOD-5 (mg/1), turbidity (JTU) and pH. The five quality measures were the only ones for which numerical values could be obtained across all use classifications, a requirement dictated by the index approach. Particular attention was given to state water quality standards (North Carolina Environmental Management Commission, Dorfman 1972)) because they report specific critical water quality parameters associated with a set (usually four or five) of descriptive water quality classifications. The consensus results for each quality level are summarized in Table 1.

¹Sources consulted include Thomann (1971), U.S.G.S. (1978), Pickle et al. (1973), Davis (1968)), Economics Research Associates (1979), Katz (1969), Dorfman et al. (1972), North Carolina Environmental Management Commission, APHA, AWWA and FSIWA (1955), National Technical Advisory Committee (1968), NAS-NAE (1972), EPA (1976), Davidson, Adams and Seneca (1966), National Planning Association (1975).

Table 1. Consensus Water Quality Characteristics of Five Water Quality Classes

Water Quality Classification	Petal Coliforms (#/100 ml)	Measurable Water Dissolved Oxygen (mg/1) A	5-day BOD (mg/1)	Turbidity (JTU)	Ph	
Acceptable for drinking without treatment	0	7.0 (90)	0	5	7.25	a-
Acceptable for swimming	200	6.5 (83)	1.5	10	7.25	-11
Acceptable for game fishing	1000	5.0 (64)	3.0	50	7.25	ω
Acceptable for rough fishing	1000	4.0 (51)	3.0	50	7.25	
Acceptable for boating	2000	3.5 (45)	4.0	100	4.25	

 $[\]underline{a}$ /
Percent saturation at 85°F in parentheses

In order to associate each of the five possible sets of scientific measures with a single-valued ordinate or the quality ladder a truncated version of the National Sanitation Foundation Water Quality Index (WQI) was used:

$$WQI = \frac{5}{11} \frac{\hat{\omega}}{9} \frac{1}{10}$$

where

qi the quality of the ith

parameter, a number from

0 to 100 obtained from the

transformation functions for

water quality measures in

McClelland (1974).

the weight assigned to the ith parameter. The original weights

(w_i) reported in McClelland (1971)

cover nine quality measures and

2 = 1.00

Our adjusted weights cover a

smaller number of measures which also

sum to 1.0 from:

$$\hat{\omega}_{i} = \omega_{i} \left(\sum_{i=1}^{5} \omega_{i} \middle/ \sum_{i=1}^{5} \omega_{i} \right)$$

The resultant ladder appears in Figure 1.

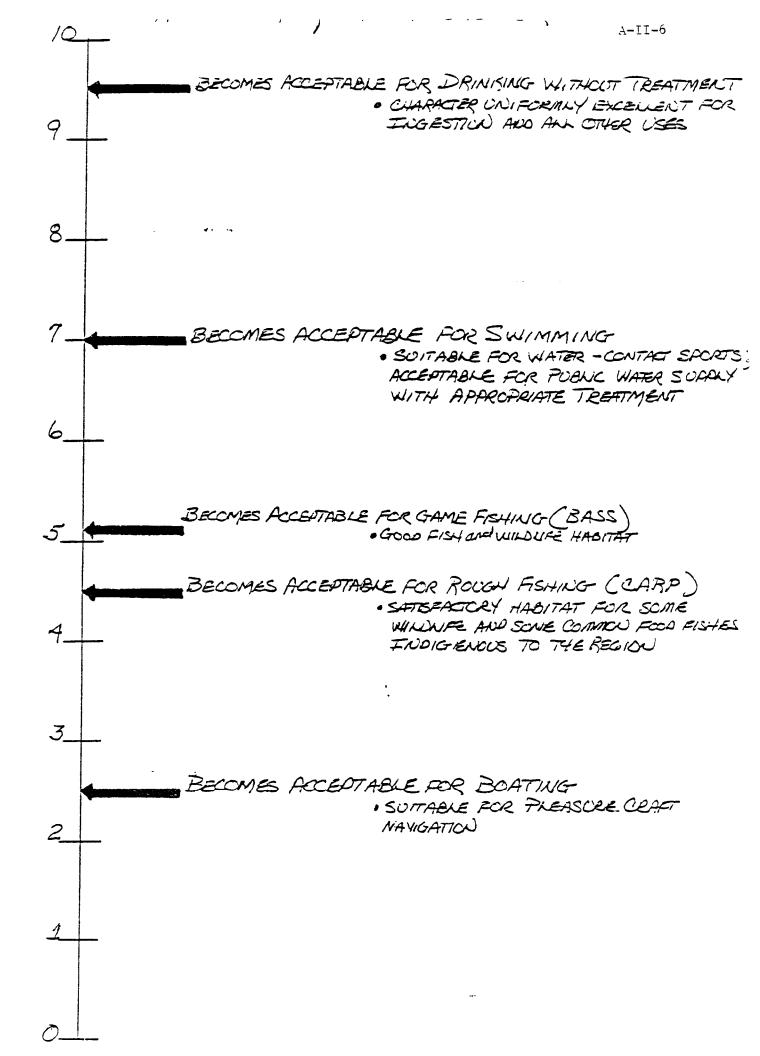
For example, the index value for the "Acceptable for Rough Fishing" classification was developed as shown below:

	<u>Value</u>	Scaled Value (q_i)	Weight (w ₁)	Weighted Scale Value (qii)
<u>Characteristic</u>				
Fecal Coliform	1000/100m1	20	0.242	1.985
Dissolved Oxygen	51 2ª /	44	0.274	2.820
Max 5-Day BOD	3 mg/1	74	0.161	2.000
Turbidity	50 JTU	38	0.129	1.599
17Ph	7.25	93	0.194	2.049
Index $\left(\frac{5}{1} q_{i}^{w} \right)$	10)			4.5

Notes:

<u>a/</u> Percent saturation at 85°F.

Similar calculations for the remaining four classes yield the water quality ladder shown in Figure 1.



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Appendix III DERIVATION OF PUBLIC GOODS EXPENDITURES

The estimated public goods expenditures used in this study to "anchor" the amounts displayed on the payment cards are shown in Table I below:

Table 1: Public Goods Expenditure Estimates for Versions A, B, C, D by Income Class

Income Category	Publi	c Good (Ave	rage Expen	diture per	Househol	d)
	Defense	Education	Highways & Roads	Water Pollution	Police & Fire	Space
I. Less than \$10,000	\$ 322 (402)	\$ 204 (255)	\$ 98 (123)	\$ 61	\$ 33	s 13 (16)
II. \$10-15,000	676 (845)	446 (557)	192 (240)	125	70	27 (34)
III. \$15,25,000	1337 (1671)	882 (1103)	312 (390)	245	139	53 (66)
IV. \$25	3013 (3766)	1988 (2485)	626 (782)	562	313	120 (150)

These amounts were used to anchor the payment card amounts as follows:

- 1. Version A used four public goods (Defense, Education, Highways, and Space Program).
- 2. Version B used five public goods (Defense, Education, Highways, Police and Fire Protection, and Space).
- 3. Version C used the four public goods listed for A. The public goods expenditures used in Version C were 25% higher than those used in Version A. These amounts are shown in parenthesis.
- 4. Version D used the four public goods and amounts as in Version X <u>plus</u> the amounts shown from Water Pollution.

Methodology

Since we desired to take account of public goods expenditures that were the result of both direct taxes and indirect taxes (usually reflected in higher prices) we used a formula that took into account both direct and indirect taxation. Using the federal tax structure as our base, 43% of taxes come from income taxes (direct) while 57% come from other taxes and charges. Internal Revenue Service figures are also available on the average amount of income tax paid by income category. Aggregating the IRS categories by the weight of the percent of the population in that category, we obtained the average federal income tax paid by our four income classes.

The following formula was used to determine total household expenditures for the federal budget.

or

<u>Average Federal Income Tax Paid</u> = Total Federal Household Expenditures

It is now possible to solve the equation for total federal household expenditures since average federal income tax paid is known and .43 is a constant representing the ratio of income tax to total federal revenues.

An exception to this procedure was made in the case of the \$0-5,000 income categories. These categories are not included in our calculations for the under \$10,000 income class because they pay almost no income taxes and would have distorted our estimate of the non-income expenditures on public goods for the under \$10,000 income class. Hence, our estimates of average federal income tax paid by those in the under \$10,000 category are biased upward.

From the 1980 United States Budget, defense spending accounts for 24% of total federal expenditures. To calculate a household's (in a given income category) expenditures for defense the following formula was used:

24% x (Total Household Federal Expenditures) = Household Defense
Expenditure

Expenditures for other public goods were calculated using defense spending as a base.

(HED)
$$\times \left[\frac{(TEPGX)}{(TFDE)}\right] = HEPGX$$

where HED = Household Expenditure on Defense

TEPGX = Total Expenditures on Public Good X

TFDE = Total Federal Defense Expenditures

HEPGX = Household Expenditures on Public Good X

For a household in income level I (under \$10,000 annual income), expenditures on highways and roads were calculated as follows:

$$$322 \times \frac{(\$33,700,000,000)}{(\$125,200,000,000)} = \$98$$

where HED = \$322 TEPGX = \$33,700,000,000 HEPGX = \$98

Public Good X = Highways and roads

Estimation Problems

The estimates of the public goods expenditures by income category are only intended to be rough "ball park" figures. They are plagued by a number

²The estimates of expenditures on highways and roads included the folowing correction factor to take account of the regressive nature of gasoline taxes which are largely responsible for financing this public good. For income category I (under \$10,000) the estimated household expenditure on highways and roads was multiplied by 120%. For income categories II, III, and IV, the correction factor was +10, and -20, respectively.

of problems some of which are not easily tractable. Since we are attempting to obtain estimates of willingness to pay for water quality at the time of the interview, it is desirable to use as current as possible estimates of expenditures on other public goods. This desire presents three alternatives:

(1) using the latest year for which estimates were available for all public goods used which in our case would have been 1976, (2) make the heroic assumption of determining the rate at which expenditures on each public good changed since the last good estimate available, (3) use the latest year available for each public good. We have chosen the third alternative, as the drawbacks of non-comparable years appeared better than old numbers in the case of (1) and the expansion and contraction of several public goods such as water pollution control, defense, and highways out of sinc with any of the standard indexes precluded easy use of (2).

Discrepancies in definitions also pose estimation problems in the case of the Census Bureau's household definition and IRS's definition of non-business income tax returns. In our case, there are 77 million households and 87 million individual and joint income tax returns. We chose to consider households and IRS tax returns and equivalent for the purpose of computing average federal income tax paid.

The most heroic assumption we made was that the other 57% of the federal budget is collected in the same proportion as income tax. These indirect taxes are largely consumption taxes; hence this assumption is probably not warranted. If the public goods expenditures on the payment card showed itself to be sensitive to the exact amount given, then a major effort would be required to achieve more accurate estimates of these expenditures.

Version A and Version C of this survey were explicitly designed to test this sensitivity.

With the exception of the purely federal expenditures of defense and space, our implicit assumption of uniform national expenditures by income category is questionable although highways and roads and water pollution control expenditures violate this assumption to a lesser degree than do police and fire or public education expenditures. (I.e., a resident of New York City pays much more for police protection than does someone in rural Iowa). Further, the respondent, if he or she is familiar with public goods expenditures is most likely to be familiar with expenditures on these two highly local public goods. If our estimates are significantly different from the respondent's perceptions of what they are, the survey may lose credibility in the eyes of the respondent. The extent of this problem, if any, was not explored.

Sources

- A. Tax figures -- 1976 IRS preliminary estimates
- B. Total-federal income, defense expenditures, space expenditures -- Budget of the United States, 1980.
- C. Education figures -- HEW preliminary estimates for primary and secondary education expenditures during the 1978-79 school year.
- D. Highways and roads -- American Highway and Transportation Builder's Association for 1978.
- E. Water Pollution -- CEQ estimates for total expenditures on water pollution control (December 1978).
- F. Police and Fire -- Facts and Figures on Government Finance (Tax Foundation, Inc., 1979).

National Environmental Survey

for the President's Council on Environmental Quality

These results are based on a probability sample of 1576 persons, age 18 and over living in the continental United States excluding Alaska. Initially 1286 persons were interviewed in person between January 26 and February 9, 1980. An additional sample of 280 persons were interviewed in person later in March to bring the sample size up to 1576.

All the data reported here have been weighted using standard procedures to compensate for minor variations between the final sample and the actual distribution of basic population characteristics.

In order to include as many questions as possible in the instrument, the sample was split into two equivalent samples. Most questions were asked of the entire sample but some were asked only of the X or the Y half. These questions are identified on the questionnaire. The sample size for the X version is 840 and that of the Y sample is 736.

Robert Cameron Mitchell Senior Fellow

STUDY NO.684 (1902) JANUARY 1980 COUNTY	FLACE	Blx.# X 5-1
OMB Clearance Number: 116F-79025		
Time Started Time Finished	Total Minutes	6/?
Hello, I'm from ROPER AND CANTRIL and we're conduct: States Government getting people's views about some of the probles survey is entirely "oluntary. All information will be held in the produce overall statistical reports. We would very much value you	rs the nation faces. You strictest confidence a	ur participation in thi.
 First, I would like to ask you which three of these national produced most of its attention, to in the next year or two? (HANG) 		o see the government
a. Reducing racial discrimination	13%	8/
b. Reducing the amount of crime	51	9/
c. Beautifying America	5	10/
d. Conquering "killer" diseases	41	11/
e. Reducing pollution of air and was	ter 24	12/
f. Helping people in poor areas	29	13/
g. Reducing unemployment	48	14/
h. Improving highway safety	-	15/
1. Improving housing and run-down ne	eignporhoods 20	16/
J. Improving public education	35	17/
None	1	18/
No opinion	7	19/
2. There is a lot of talk these days about what the aims of this cathis card are listed some of the goals which different people would you please say which one of these you, yourself, consider	would give top priority.	
	(Col.20)	(Col.21)
a. Maintaining a high rate of economic growth	27%	2-03
b. Making sure that this country has strong defense forces	1.4	26
c. Seeing that people have more say in how things get decided at work and in their communities	19	22
d. Protect nature from being spoiled and polluted		2:
None		
No opinion	_	<u>.</u>
3. And which would be the next most important? (RECORD ABOVE)		
4. If you hid to choose, which one of the things on this card would RESPONDENT CARD)	id you say is most desir	able? (HANC
	<u>4.</u>	<u> 5.</u>
	Most	Second
	desirable (Col.22)	(Co 1 . C3)
a. Maintaining order in the nation	16%	251
p. Giving the people more say in important movernment	: decisions	
c. Fightir: rising prices	13	. .
d. Protecting freedom of speech		22
None		• -
No opinion	_	- - -
	• • • • • • • • •	~

5. mast yould be join should chouse - PECORD As No.

6. Here is another list. (HAND RESPONDENT CARD) In your opinion, which one of these is rost important?

		6. Most Important (Col.24)	Next most important (Col.25)
a.	Maintaining a stable economy	5 5 %	24%
b.	Progress toward a less impersonal, more humane society	3	14
c.	The fight against crime	2-	5 7
đ.	Progress toward a society in which ideas can count more than money	9	22
	None	1	3

- 7. Which is next most important? (RECORD ABOVE)
- 8. Here is a card that includes all of the goals listed on the three cards you have just looked at. (HAND RESPONDENT CARD) Would you tell me which one of the goals on this card you consider the most desirable of all

	8 Most desirable (Cols.19,27)	Next Fost desirable 'Cols.23,29'	10 Least important (2018.20,21
a. Maintaining a high rate of economic growth	3°;	\$2	3 ² ,
b. Making sure that this country has strong defense forces	24	13	3
c. Seeing that people have more say in how things get decided at work and in their communities	5	5	Ş
d. Protecting nature from being spoiled and polluted	2	3	j
e. Maintaining order in the nation	5	~ .	-
f. Giving the people more say in important government decisions	6	5	4
g. Fighting rising prices	25	1-	2
n. Protecting freedom of speech	2	3	-
i. Maintaining a stable economy	11	14	<u> </u>
J. Progress toward a less impersonal, nore humane society	2	2	**
k. The fignt against crime	5	15	÷
1. Progress toward a society in which ideas can count more than money	3	3	16
None			•
No opinion	<u>.</u>	1	3

y. Which is the fewt most described (RECORD ABOVE)

II. Aud witch one of the sime on the short as legates posters from posters and the least of the same o

Now, I'd like to find out how worried or concerned you is common number of problems and placed and a common of problems and placed about nome of these matters, don't hesitate to day so Corot, reduction. (ASK ABOUT COCK ITEM)

	•		Not Pery			
a. How worried or concerned are you alout the rise in prices and the cost of living?	31%	16%	2 %	1 2-	-	1.7
b. The problems of the poor	11	42	11	2	:	33/
c. Cleaning up our waterways and reducing water pollution?	39	11	13	3	:	347
d. CMITTED					No col.	3.5
e. Reducing the amount of unnecessary noise in this community?	11	20	34	34	1	35/
f. Shortages of oil, gasoline, coal, natural gas, electricity, or other fuels?	- 5	18	5	2	1	37/
g. Reducing air pollution?	36	10	16	-	· -	35/
h. The purity of the drinking water in your community?	42	27	10	13	:	39/
i. CMITTED					No col.4	0

Question asked for RFF in separate Roper survey, March 1980:

9. Now, I'd like to find out how worried or concerned you are about a number of problems I'm going to mention: a great deal, a fair amount, not very much, or not at all. If you aren't really concerned about some of these matters, don't hesitate to say so. First, (ask about each item)

		A great <u>deal</u>	i fair <u>anount</u>	Not very <u>much</u>	Not 25 222	No <u>opinion</u>
a.	How worried or concerned are you about the rise in prices and the cost of living?	\$6 [°] ;	11%	2%	• 0;	-
b.	The presence of toxic chemicals such as pesticides or PCBs in the environment?	∸ 6	32	16	1	· .
c.	Cleaning up our waterways and reducing water pollution?	54	33	10	2	<u>:</u>
d.	The disposal of industrial chemical wastes that are hazardous?	64	26	-	2	: